

Field Raman Spectrograph for Environmental Analysis

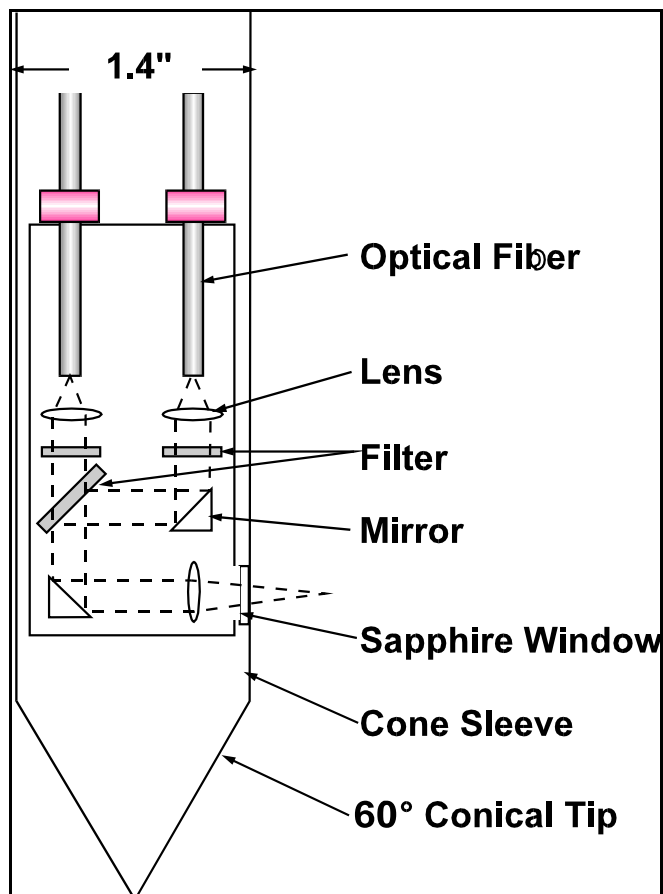
Technology Need:

The Department of Energy's (DOE) Environmental Restoration program needs innovative technologies to provide highly specific, *in-situ* chemical analysis of waste materials stored in underground tanks and contaminants present in subsurface soils and aquifers. Typically, sample analysis is performed in an analytical laboratory, which can be slow and expensive. Existing field methods for *in-situ* analysis lack sensitivity in quantification and typically do not indicate chemical speciation.

Technology Description:

Raman Spectroscopy is an optical method capable of detecting various organic and inorganic chemicals. This method is applicable to both dilute and concentrated wastes and is capable of identifying chemical speciation and determining the chemical concentration. The technique uses laser light to cause molecules to vibrate in a distinctive way, creating a vibrational "fingerprint", that can be captured, transmitted, and analyzed with respect to other known vibrational signals.

For this project, the Raman Spectrograph has been integrated with Cone Penetrometer Technology (CPT) to allow *in situ* chemical analysis of tank waste and subsurface contaminants. The Raman probe for CPT utilizes fiber optics to transmit the laser energy to the material being analyzed and to return the collected signal to the spectrometer. A schematic of the Raman probe is provided as Figure 1. The Raman probe contains a sapphire window through which the laser beam is transmitted to the material of interest. The Raman probe for CPT, is capable of remotely analyzing material located at depths greater than 50 meters. The system is suitable for detection of highly concentrated materials and is capable of analysis to parts-per-billion



levels with specially designed probes.

The portable Raman spectrograph and associated sampling accessories can be used in the field for screening, monitoring, and identification of a wide variety of contaminants. This instrumentation development project combines fiber optics, Raman Spectroscopy, Echelle grating, lasers, micro-optical lenses, charged-coupled devices, and fiber-optically coupled probe heads.

Benefits:

- In situ detection, characterization, and mapping of previously unknown concentrated wastes.

- Detection of corrosion products on storage tank interiors.
- Characterization of dilute waste plumes which require more sensitive analytical methods.
- In situ* analysis eliminates costly laboratory testing.
- Near real-time on-site identification of contaminants as compared to off-site labs.
- More complete and cost-effective site mapping than is possible with drilled and excavated wells.
- All hardware is suitable for high radiation, highly caustic chemical environments.

Status and Accomplishments:

This project was completed in September 1998. The technology has been demonstrated and deployed for two primary application: analysis of tank waste and *in-situ* subsurface characterization. In the area of subsurface characterization, most of the work has focused on detection of Dense Non-Aqueous Phase Liquids (DNAPLs). Demonstrations and deployments include:

- In 1996 the technology was demonstrated at Oak Ridge in for testing on radioactive tank sludge samples
- In 1997 demonstration testing was conducted at Fernald Environmental Management Project, Plant 1
- In 1998 the technology was demonstrated in 3 areas (321-M, M-Area Basin, C-Area Burning Rubble Pit) at Savannah River Site (SRS) using DOE SCAPS truck
- In 1998 the technology was deployed at Cape Canaveral Air Station (Kennedy Space Center)
- In 1998 the technology was demonstrated at the Hanford Site Test Area and was deployed at the SRS 321-M Area
- In 1999 the technology was demonstrated at a commercial dry cleaning site in Jacksonville, Florida
- In 2000 the technology was deployed at the Savannah



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River Site's Pen Branch Project

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Online Resources:

Office of Science and Technology, Technology Management System (TMS), Tech ID # 873 & 1544
<http://ost.em.doe.gov/tms>

The National Energy Technology Laboratory Internet address is <http://www.netl.doe.gov>

An Innovative Technology Summary Report (ITSR) is available for the Raman Probe (TMS 1544) technology at <http://apps.em.doe.gov/ost/pubs/itsrs/itsr1544.pdf>

For additional information, please visit the EIC Laboratories, Inc. website at <http://www.eiclabs.com/>